International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Gandhian Principles for Subnational Disaster Governance and Economic Resilience A Qualitative Assessment of Flood-Risk Reduction and Local Institutions in the Kosi Basin, Bihar, India

Gade Rajkumar[1], Kuchu Jayasree[2], S. Mohammed Irshad[3]

[1]Vice President, Global Alliance for Sustainable Development, Pune, India
[2]Associate Professor, Department of Civil Engineering, Vasavi college of engineering, Hyderabad, Telangana, India
[3]Assistant Professor, Centre for Disasters and Development, Jamshedji Tata School of Disaster Studies, Tata Institute of Social Sciences, Mumbai, India

Abstract

The Kosi Basin in northern Bihar is exposed to recurrent floods, river-channel instability, sedimentation and cross-border hydrological risks. Although embankments, a barrage and disaster-management institutions have shaped the regional response, structural protection alone cannot address unequal exposure, insecure livelihoods and weak last-mile preparedness. This article examines whether selected Gandhian principles—Swaraj (self-rule), Swadeshi (local capability), trusteeship, non-violence, service and attention to basic needs—can inform a more participatory approach to subnational disaster governance. The study draws on a qualitative case study in Supaul district, involving field observations, discussions in ten villages, a limited number of household surveys and focus-group discussions, key-informant interviews and documentary analysis. It interprets the reported perceptions of affected households and local institutions alongside published river-science research and relevant policy frameworks. The analysis identifies recurring concerns about dependence on higher administrative tiers, livelihood disruption, financial insecurity and uneven access to actionable warnings. It also recognises documented community-led warning initiatives and the need to avoid portraying local institutions as uniformly inactive. The paper proposes a practical Gandhian governance lens linking gram sabha participation, inclusive preparedness, transparent local finance, scientific forecasts, community knowledge and India–Nepal coordination. The central argument is that community autonomy must complement, not substitute for, capable public institutions and evidence-based river management. Because the manuscript does not provide complete interview records, dates or respondent characteristics, its empirical findings are interpreted as exploratory rather than representative.

Keywords: Gandhian Philosophy, Disaster Risk Governance, Kosi Basin, Panchayati Raj, Flood Preparedness, Local Resilience, India-Nepal Cooperation.

1. Introduction

Flood risk is created not only by physical hazards but also by the exposure of settlements, dependence on fragile livelihoods, the accessibility of services and the capacity of institutions to act before a hazard becomes a disaster. The Sendai Framework places risk understanding, governance, resilience investment and preparedness within one agenda (UNDRR, 2015) [1]. Its emphasis on the social production of risk is especially relevant in the north Bihar floodplain, where floods intersect with land tenure, poverty, temporary displacement, agricultural production and public-service delivery (Singh et al., 2009; UNDRR, 2022) [2, 3]. Climate change adds uncertainty to rainfall, high-mountain water systems and livelihoods; regional projections should nevertheless not be interpreted as evidence that every individual flood was caused by climate change (IPCC, 2022; ICIMOD, 2023) [4, 5].

The transboundary Kosi flows through the Himalayan region of China and Nepal before entering Bihar and joining the Ganga. High relief, sediment supply, monsoon runoff and an extensive alluvial fan contribute to the system's mobility. The river's 2008 embankment breach and avulsion exposed the limits of relying on an assumed permanent channel alignment (Dixit, 2009; Sinha, 2009) [6, 7]. India and Nepal have jointly developed major hydraulic works, yet the consequences of flood management are distributed unequally among embanked settlements, downstream communities and irrigation beneficiaries (Government of India and Government of Nepal, 1966; Singh et al., 2009) [8, 2]. A nuanced assessment must recognise both the benefits of flood-control infrastructure and the residual risks that remain around it.

This paper brings these questions into dialogue with Gandhian ethics. Gandhi's vision of Swaraj prioritised responsible self-government, human dignity, restraint and the ability of communities to meet essential needs; it offers a normative framework for evaluating development choices, not a ready-made hydraulic design (Nachane, 2007; Moolakkattu, 2019) [9, 10]. The research question is: how can these principles be translated into workable responsibilities, resources and accountability arrangements for flood-prone gram panchayats? The central proposition is that effective subnational disaster-risk reduction requires locally informed decision-making supported by technical information, finance and intergovernmental coordination. The paper first examines the Gandhian framework, then reviews Kosi hydrology and institutions, and finally interprets the author's qualitative field observations and proposes an operational governance model.

2. Literature Review and Research Gap

This review brings together Gandhian political economy and environmental ethics, the literature on floodplain hazards and embankments, and contemporary disaster-risk governance. These literatures are complementary but do not by themselves establish that adopting Gandhian values would measurably reduce flood losses. The specific research gap addressed here is how those values might be translated into testable responsibilities, decision processes and accountability measures at the gram panchayat level [4, 2, 1, 3].

2.1 Gandhian Economic Thought and Disaster Risk

Gandhian economics is relevant to disaster-risk reduction because it asks whether development first secures basic needs and dignified livelihoods. Kaur et al. (2015) [11] identify Swadeshi, village industries and reduced dependence on external markets as important elements of Gandhi's economic outlook. Nachane (2007) [9] similarly describes the tension between a human-centred economic vision and the priorities of centralised modern economic planning. These ideas should not be read as an argument against

modern science, but as a prompt to examine who benefits from investment, who bears residual risk and which capabilities remain within the community.

The economic vulnerability of flood-exposed households is multidimensional. Damage to dwellings and crops may be accompanied by lost wages, indebtedness, interrupted schooling, poor access to health services and migration. The Kosi case study of Singh et al. (2009) [2] records adjustments in cropping, livelihoods, water use and mobility that households developed in response to repeated water stress. Such adaptive practices illustrate agency, but they may also represent constrained choices rather than satisfactory protection. Economic resilience therefore depends on secure assets and functioning public infrastructure as well as local initiative (World Bank, 2018; UNDRR, 2022) [12, 3].

In a disaster context, trusteeship can be operationalised as transparent stewardship of common assets, public funds, water infrastructure, emergency supplies and shared shelters. Swadeshi suggests supporting local repair skills, small enterprises, community storage and locally suitable building materials without excluding outside expertise when indispensable. The principle of bread labour highlights the value of remunerated local maintenance, drainage clearance and ecosystem restoration, provided labour standards and safety are respected. Nagler (2013) [13] offers a contemporary interpretation of this needs-based orientation, although his recorded lecture is a contextual source rather than peer-reviewed empirical research.

A Gandhian approach cannot equate self-sufficiency with the withdrawal of state responsibility. Poor households should not be expected to finance their own protection when risks exceed local capacity. Instead, decentralised planning can combine locally determined priorities with guaranteed public expenditure, technical support and social protection. A useful evaluative question is whether a proposed flood-management investment reduces the material and social vulnerability of the least secure residents, including landless labourers and women-headed households, rather than simply maximising engineering outputs (UNDRR, 2015; Singh et al., 2009) [1, 2].

2.2 Gandhian Environmental Ethics

Gandhi's ethical critique of excessive consumption is closely connected with questions of ecological stewardship and justice. Moolakkattu (2019) [10] interprets his environmental ideas as an approach grounded in limits to material wants, the dignity of work, village life and the interdependence of society and nature. Gupta (2017) [14] similarly situates Gandhian thought within debates about industrialisation and environmental protection. Neither interpretation implies that Gandhi anticipated contemporary hydrological models; rather, his ideas help evaluate the distribution of environmental costs and benefits.

The Himalayan headwaters of the Kosi contain snow, glaciers, steep slopes and monsoon-affected catchments. Climate change is altering high-mountain cryospheric systems and may change seasonal water availability and hazard profiles, although particular flood events depend on multiple interacting conditions (ICIMOD, 2023; IPCC, 2022) [5, 4]. Landslides also introduce sediment and temporary channel blockages. A basin-specific study shows that rainfall- and earthquake-triggered landslides have differing spatial and size characteristics, indicating the need for differentiated risk assessments rather than one generic cause (Zhang et al., 2019) [15].

From a Gandhian perspective, environmental management in the Kosi Basin would combine catchment care, floodplain land-use choices, sustainable livelihoods and careful evaluation of hydraulic works. Protecting river corridors and sustaining locally useful ecosystems can complement, but cannot replace, flood forecasting, embankment inspection, evacuation routes and engineered protection where necessary. An evidence-based environmental ethic must avoid the simplistic proposition that floods are punishment

for human greed: physical hazards have measurable geological and meteorological mechanisms, while disaster losses are shaped by social decisions.

Gandhi's response to the 1934 Bihar earthquake is historically associated with a moral interpretation of the event. That interpretation is not offered here as a scientific explanation. The relevant contemporary contribution of Gandhian thought lies instead in non-discrimination, concern for people facing disadvantage, and an obligation to protect human dignity before, during and after disasters.

2.3 Swaraj, Panchayati Raj and Local Accountability

Swaraj is a concept of self-government that combines participation with responsibility and restraint. Applied to disaster governance, it favours regular village deliberation, public access to risk information, scrutiny of expenditure and accountable local leadership. India's constitutional arrangements recognise panchayats as institutions of self-government, but Article 243G makes the actual devolution of powers and responsibilities dependent on state legislation; constitutional recognition does not itself guarantee adequate staffing or fiscal autonomy (Government of India, 1950) [16]. The distinction is central to analysing the gap between Gandhian aspiration and administrative reality.

Local authorities are close to households and can identify seasonal access barriers, informal settlements, people requiring assisted evacuation and locally trusted warning channels. District and state institutions, in turn, retain responsibilities that a village cannot discharge alone: hydrological modelling, emergency logistics, specialised rescue, financing and relations with upstream authorities. A plausible Gandhian governance model is therefore a network of complementary responsibilities rather than an isolated village. Contemporary risk-governance guidance likewise stresses coordination across sectors and levels of authority (UNDRR, 2017; Government of India, 2019) [17, 18].

The author's central institutional concern is that gram panchayats in the selected flood-prone areas have limited control over the budgets, technical staff and operational decisions required for year-round risk reduction. This is presented as a fieldwork interpretation, not an assertion that every Indian panchayat lacks such powers. An assessment of local government must distinguish legal mandates, actual transfers of functions, fiscal capacity and implementation practice. Regular gram sabha review of seasonal risk maps, embankment-condition reports, shelter readiness and inclusion measures would provide a practical means to make accountability visible.

Participation also requires safeguards. Meetings attended mainly by dominant groups can reproduce caste, gender, land-ownership or political inequalities. Representation should therefore be tested against who can speak, who receives warnings, whose assets are protected and who controls spending. The Sendai Gender Action Plan emphasises meaningful participation and leadership of women in risk decisions; these commitments are compatible with Gandhian non-discrimination and service (UNDRR, 2024) [19].

2.4 Research Gap and Contribution

Research on the Kosi has established important features of channel mobility, infrastructure risk and the social consequences of living with embankments [20, 6, 2, 7]. Disaster-governance guidance also recognises participation, inclusion and locally actionable warnings [21, 1, 19, 22]. The contribution of this article is a conceptual synthesis that uses Gandhian principles to assess the gap between formal disaster-management institutions and household-level preparedness. It does not claim to test the causal effectiveness of Gandhian governance or to provide a representative survey of the basin.

3. Conceptual Framework: A Gandhian Lens for Disaster Risk Management

The convergence between Gandhian principles and disaster-risk management is conceptual rather than

automatic. Table 1 maps values such as service, self-restraint, inclusion and community capability onto risk reduction, resilience and accountable institutions. The table is an analytical tool developed by the authors: it does not establish that applying these values independently reduces flood depth or loss rates. Any practical model must also satisfy the Sendai Framework's priorities for risk knowledge, governance, investment and preparedness (UNDRR, 2015) [1].

Table 1. Conceptual Links Between Gandhian Principles And Disaster-Risk Management

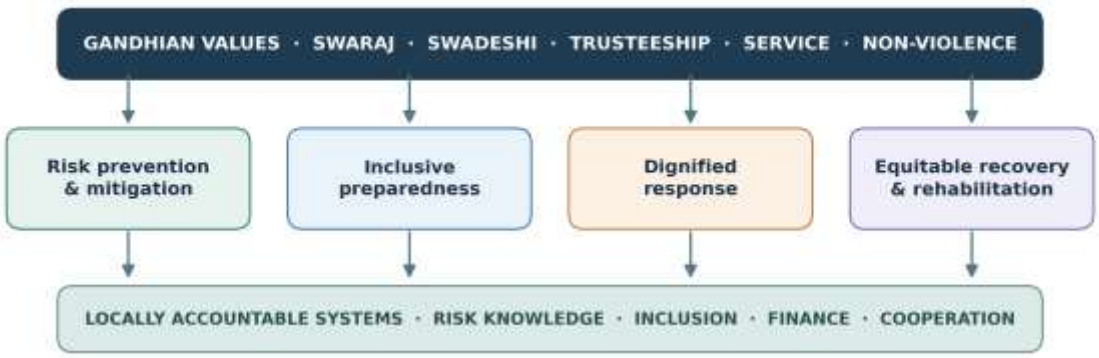
Issue	Gandhian Thoughts	Disaster management
Human	Capable	Most vulnerable
Resources	Abundance	Judiciously used
Environment	Protection	Saving Himalayan ecosystem
Emphasis	Community	Community
Objective	Service and sharing	Resilience
Philosophy	Small is beautiful	Risk reduction
Mechanism	Fight for right	Cooperation
Impact	larger	Effective and scalable
Problems	Divergent	Finding solutions
Measures	Quality of life	Safety and security of life
Institutions	Decentralised	Bureaucratic and top down
Equality	Non -Discrimination	Equity and Equality
Participation	Participatory	Inclusive
Spirituality	Human centric	Humanitarianism

Source: Authors' conceptual synthesis; interpretive rather than empirical classification.

The proposed lens has five linked functions. First, compassion and non-violence require humane, non-discriminatory evacuation and relief. Second, equality requires attention to people with disabilities, older people, children and households facing economic or social exclusion. Third, local capability involves community preparedness teams and practical knowledge of terrain, routes and household needs. Fourth, trusteeship requires transparent use of grants, public assets and common spaces. Fifth, ecological restraint demands appraisal of river-management investments for their long-term social and environmental effects. These functions reinforce accepted concepts of risk governance, which concerns the institutions and processes through which societies manage and reduce disaster risk (UNDRR, 2017) [17].

The lens should be applied to the full disaster-risk management cycle. Preparedness entails public warnings, practice drills and agreements on evacuation. Response entails timely, impartial assistance. Recovery entails safe housing and accessible livelihoods. Mitigation entails both structural safety and the reduction of avoidable exposure. Resilience is not simply recovery to the pre-disaster condition if that condition was itself unsafe (UNDRR, 2022) [3].

Figure 1. Gandhian Lens For An Inclusive Disaster-Risk Management Cycle



Source: Editorial redrawing of the authors' conceptual lens in the submitted manuscript.

At the response stage, a Gandhian approach translates into non-discriminatory relief distribution, protection of bodily safety, public communication of entitlements and accessible grievance mechanisms. The purpose is not charity alone, but the fulfilment of rights and duties while minimising humiliation and exclusion. Local volunteers and panchayats can assist, while state agencies must remain accountable for adequately resourced emergency services.

During rehabilitation and recovery, safe shelter, water and sanitation, school continuity, protection of women and children, and livelihood recovery are primary concerns. Reconstruction should be informed by expected future risk rather than an assumption that the previous dwelling location or design is always safe. Local participation in identifying recovery priorities improves legitimacy, but specialist engineering and independent quality checks remain essential (Government of India, 2019; IFRC, 2012) [18, 21].

In prevention and mitigation, the emphasis shifts to risk-informed land use, regular maintenance of protective works, nature-based measures where evidence supports them, household asset protection and reliable mobility routes. Local job creation can accompany these investments if wage arrangements and safety are appropriate. An inclusive planning process must document alternative options and the people likely to bear residual risks.

In preparedness, scientific forecasts must be translated into warnings that people can understand and act upon. The World Meteorological Organization's people-centred approach connects risk knowledge, monitoring and forecasting, warning communication, and preparedness for response (WMO, 2023) [22]. The four components are mutually dependent: a technically accurate forecast is of little use if a household cannot receive or act on it.

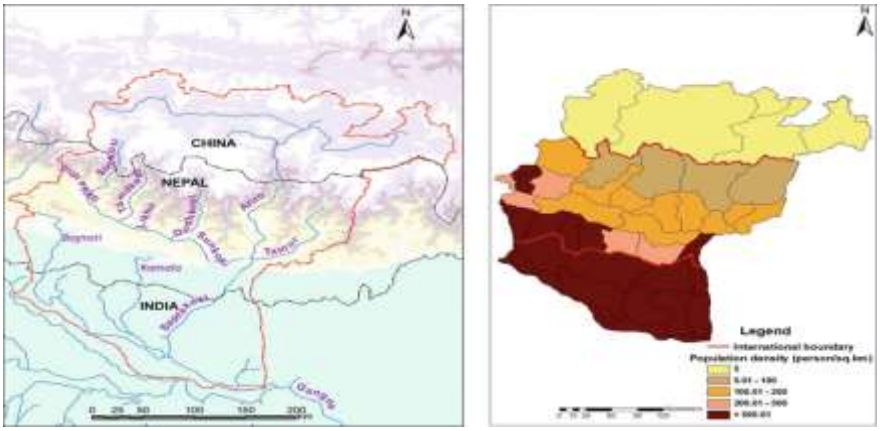
The governance hypothesis arising from this lens is testable. Villages with inclusive, resourced and routinely reviewed preparedness arrangements should be better able to act on warnings and protect essential assets than villages without those arrangements, all else being equal. The present exploratory study cannot demonstrate this causal relationship; future comparative fieldwork would need baseline indicators and repeated observations.

4. Study Area: Kosi Basin Hazards, Infrastructure and Social Exposure

The Kosi is a transboundary Himalayan river system shared by China, Nepal and India. Catchment estimates vary with delineation and source, but the hydrological system is characterised by pronounced relief, multiple tributaries, sediment mobilisation and a low-gradient alluvial fan in northern Bihar (Chen

et al., 2013; Shrestha et al., 2024) [23, 24]. The socioeconomic significance of the river is substantial: it supports irrigation, livelihoods and ecosystems while exposing settlements to flooding and channel change. Figure 2 illustrates the basin's drainage pattern and the concentration of settlements in the downstream plains. Regional exposure patterns should not be confused with verified village-level population counts.

Figure 2. Kosi Basin Drainage And Population Concentration (Original Manuscript Image)



Source as supplied by authors: ICIMOD. Exact map product and reproduction permission require confirmation.

The downstream plains support intensive agriculture and relatively dense rural settlement. Population exposure varies by site, elevation, embankment position and quality of access routes. The vulnerability question is therefore not simply how many people live in the basin, but how flood hazards interact with housing, land tenure, essential services and the capacity to relocate or recover (Singh et al., 2009; World Bank, 2018) [2, 12].

4.1 Geomorphological Complexity

The principal tributaries include the Sun Kosi, Arun and Tamor, which converge upstream of Chatara in Nepal; the river later crosses into India and joins the Ganga near Kursela. Steep Himalayan catchments supply water and sediment to a comparatively flat alluvial plain. Variations in monsoon rainfall, channel geometry, floodplain topography and sediment accumulation contribute to a spatially uneven flood hazard (Chen et al., 2013; Zhang et al., 2017) [23, 25].

Sediment dynamics are particularly important. The Kosi drains geologically active terrain, and sediment deposited as stream gradient declines can raise channel beds and alter the location and severity of flooding. Kumar (2015) [26] examines the interaction of high sediment loads with flood-management options. River training and embankments may protect designated areas but can also require recurrent maintenance and leave residual risks around breaches, drainage congestion or channel change (Dixit, 2009; Shrestha et al., 2024) [6, 24].

Early work described the Kosi as an inland delta and documented substantial historic channel displacement (Gole et al., 1966) [27]. More recent analysis of historical maps and deposits questions the simple narrative of steady one-way westward migration, favouring more complex avulsion and channel switching (Chakraborty et al., 2010) [20]. The paper therefore treats the image in Figure 3 as an illustrative depiction of channel mobility, not proof of a continuous 220-year migration path.

Figure 3. Illustrative Historical Course Changes Of The Kosi River (Author-Supplied Image)



Source: Image retained from the original manuscript; provenance and rights require author verification. Interpretation follows Gole et al. (1966) [27] and Chakraborty et al. (2010) [20].

The 2008 Kusaha embankment breach illustrates how a river can rapidly occupy an alternative channel when hydraulic and geomorphic conditions align. Contemporary accounts document major social disruption; the event should not be reduced to a single causal explanation such as rainfall or sediment alone (Dixit, 2009; Sinha, 2009) [6, 7]. This experience supports a risk-management strategy that monitors infrastructure integrity, sediment conditions and alternative flow paths, and maintains evacuation plans for communities both inside and outside nominally protected areas.

4.2 Multiple and Interacting Hazards

Monsoon floods in the Kosi system can be shaped by intense rainfall, tributary inflows, sediment movement, riverbank erosion, channel avulsion, infrastructure breaches and, in some high-mountain settings, landslide-dammed lakes. These processes occur at different scales and should be analysed separately before they are combined into a forecast or risk scenario (Chen et al., 2013; Zhang et al., 2019) [23, 15]. Climate-driven changes in snow, glaciers and precipitation may affect future hazards, but the direction and magnitude depend on location and time horizon (IPCC, 2022; ICIMOD, 2023) [4, 5]. An effective response requires multiple layers of information: upstream hydrometeorological data, local observations, infrastructure inspection and household exposure profiles.

Flood and dry-season water stress also have consequences for agriculture, drinking-water access, health and mobility. A development-oriented risk framework must therefore address seasonal livelihood security rather than limit disaster management to the days immediately following a flood. Research in the basin shows that people have long employed diverse cropping patterns, migration and locally devised adaptation measures, but the effectiveness and fairness of these practices differ by household resources (Singh et al., 2009) [2].

4.3 Communities, Embankments and Unequal Vulnerability

The Kosi Project emerged from bilateral planning to control floods and expand irrigation and power-related opportunities. Construction of the barrage and embankments changed patterns of river access, protection and exposure. Affected groups include people between embankments, households in nominally protected areas vulnerable to breaches and waterlogging, and households in downstream or unembanked settlements. The resulting distribution of costs and benefits is contested and cannot be summarised as either complete success or complete failure (Dixit, 2009; Singh et al., 2009) [6, 2]. The 2008 breach reinforced the need to examine risks beyond design assumptions and administrative boundaries.

The earlier ICIMOD-supported research documented livelihood adaptation, landlessness, waterlogging and uneven access to public support in a selection of Kosi villages (Singh et al., 2009) [2]. These findings provide context for the present paper's field observations. They do not establish the present condition of every affected settlement, and published conditions at different dates should not be treated as contemporaneous without additional field verification.

4.4 India–Nepal Cooperation and the Kosi Agreement

India and Nepal signed the original Kosi Project agreement on 25 April 1954 and a revised agreement on 19 December 1966. The official text identifies flood control, irrigation, hydropower and the protection of specified Nepalese areas as purposes of the works (Government of India and Government of Nepal, 1966) [8]. Treaty history matters because Kosi water and sediment processes cross national borders while public accountability and warning chains operate through different jurisdictions.

A bilateral agreement on infrastructure does not in itself ensure reliable household-level flood warnings, common exposure assessments or equitable recovery. The practical cooperation agenda also includes routine exchange of observations, agreed warning thresholds, multilingual communications and coordination between national agencies and district and local officials. Technical advances in flood modelling now create opportunities for stronger basin-wide decision support, but data gaps and operational responsibilities remain important constraints (Shrestha et al., 2024) [24].

Assessments of the India–Nepal water relationship show that perceptions of benefit, risk and sovereignty influence cooperation. A Gandhian interpretation stresses mutual respect and shared human security, while recognising that these ethical values must be translated into enforceable operating procedures and transparent institutions. Cross-border systems are most valuable when warning information reaches households with enough lead time for practical action (Bajracharya et al., 2021) [28].

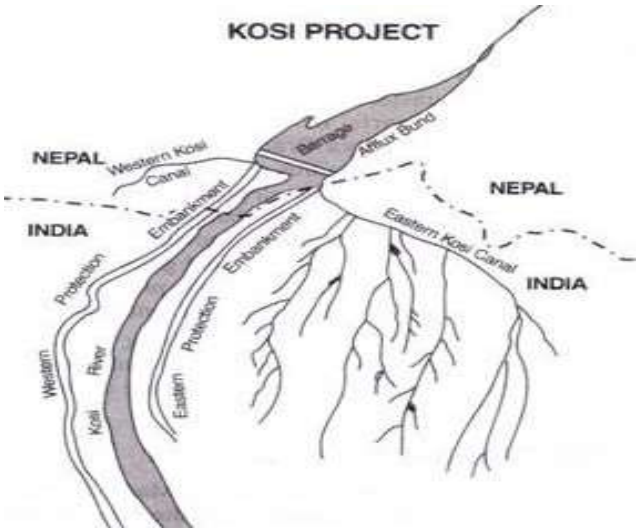
The study addresses three questions: how do institutional arrangements shape perceived preparedness in flood-exposed villages; what vulnerabilities and warning gaps are described in the source field narrative; and how can Gandhian principles be operationalised into responsibilities that could subsequently be evaluated? Its objectives are to synthesise basin and governance evidence, interpret the reported qualitative observations, and propose a locally accountable governance framework [29, 18, 1].

5. Research Objectives and Methodology

This paper is a qualitative, exploratory case study of subnational disaster-risk governance in the Kosi floodplain, centred on selected flood-affected villages in Supaul district, Bihar. The study forms part of a wider examination of disaster governance across the India–Nepal border. Supaul was selected because of its exposure to the 2008 Kosi flood and its institutional relevance to the management of transboundary hazards. The research combines documentary analysis, on-site observation, informal narrative accounts, household enquiries, focus-group discussions and key-informant interviews. These methods can reveal

perceptions and governance processes, but they do not, without further sampling information, support statistically representative estimates.

Figure 4. Location Of The Study Area, Supaul District (Author-Supplied Map)



Source: Map supplied in the original manuscript; the original URL is not traceable and must be replaced or independently redrawn before publication.

Secondary sources examined include peer-reviewed research, governmental legislation and plans, river-basin assessments and disaster-management reports. The documentary review focuses on the development of the Kosi Project, basin hazards, district and state institutional roles, and approaches to community preparedness. The theoretical discussion is explicitly interpretive: Gandhian ethical principles are used to assess public responsibilities and possible reforms, not as substitute data for hydrological or administrative claims.

A qualitative, ethnographically informed approach was selected to understand local experiences of recurrent floods, ways of coping, knowledge of warning signals and expectations of public authorities. Narrative enquiry can help recover viewpoints that formal institutional charts miss. At the same time, interpretation requires clarity about whose voices were heard, how they were selected and whether reported statements were independently checked. This paper therefore describes first-person field material as reported perceptions unless corroborated by documentation.

Purposive selection was used to identify flood-exposed villages and informants. The original field account reports visits to ten villages, ten household surveys and ten focus-group discussions, alongside interviews with selected officials, civil-society personnel, media representatives and other knowledgeable stakeholders. The groups included community-based disaster-management committee members where available. The original records do not establish whether the ten household surveys were evenly distributed across villages, how many people joined the discussions, when interviews occurred or how consent and coding were documented. These details must be confirmed from research records rather than inferred.

Accordingly, the analysis uses thematic descriptions of perceived institutional weakness, seasonal costs, locally developed coping strategies and warning gaps. It does not calculate population prevalence, make causal statistical claims or attribute quotations to identifiable individuals. The limited, purposive sample may overrepresent communities willing to participate, and observational conclusions are not necessarily transferable to all Kosi districts. A future validation phase should document dates, sampling frames,

respondent characteristics, consent procedures, interview guides, anonymised coding and triangulation against district plans and warning logs.

6. Institutional Context: Disaster Management and Local Implementation

6.1 National and State Frameworks

The Disaster Management Act, 2005 established a statutory architecture for disaster management, including national, state and district authorities. The National Policy on Disaster Management (2009) and National Disaster Management Plan (2019) articulate a broader shift from relief to prevention, mitigation, preparedness and resilience (Government of India, 2005; Government of India, 2009; Government of India, 2019) [29, 30, 18]. These documents should not be characterised as concerned solely with emergency response: the analytical question is whether their risk-reduction provisions have translated into predictable local resources and action.

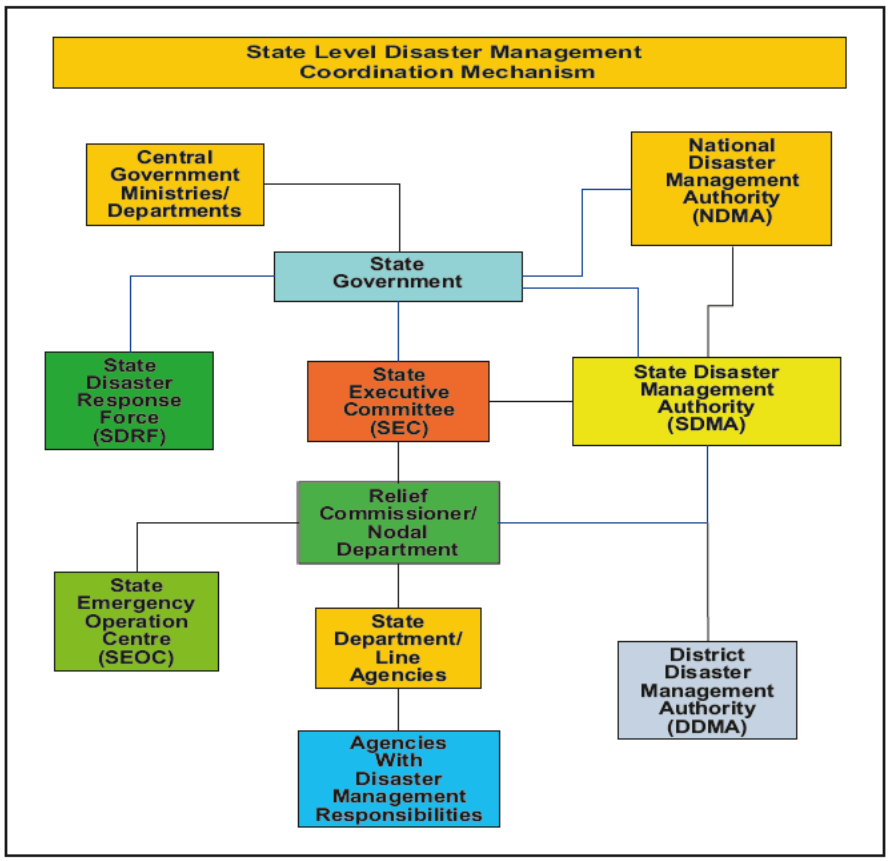
The legal framework has evolved since the period described in the original manuscript. The Disaster Management (Amendment) Act, 2025 strengthens aspects of planning, risk assessment and disaster information and enables urban disaster-management authorities. It does not by itself demonstrate that village preparedness plans have been funded or implemented; these are empirical matters requiring local evidence (Government of India, 2025) [31]. The historical field observations in this paper should therefore be read in relation to the arrangements operating when those observations were made, with the 2025 reforms acknowledged as an important subsequent development.

The guiding policy principle is that disaster risk must be incorporated across development sectors. Health, education, water supply, housing, roads, land administration and agriculture contribute materially to vulnerability even when they are not labelled disaster-management departments. The Sendai Framework expressly treats risk governance and investment as cross-sectoral responsibilities (UNDRR, 2015) [1]. The challenge for subnational administration is to link these sectoral budgets and decisions to a village-level understanding of recurrent floods.

6.2 State Disaster Management Authorities

A State Disaster Management Authority (SDMA) has responsibilities for state-level planning, policy and coordination. In Bihar, this statewide architecture operates alongside district administration and technical line departments. The 2019 National Disaster Management Plan provides an institutional illustration (Figure 5), while the 2025 legislative amendment should be consulted for the current legal distribution of planning functions (Government of India, 2019; Government of India, 2025) [18, 31]. A chart of formal authorities shows lines of responsibility, but cannot alone establish whether village-level information reaches decision-makers or whether mitigation expenditure is sufficient.

Figure 5. State-Level Institutional Coordination, As Presented In The 2019 National Plan



Source: National Disaster Management Authority, National Disaster Management Plan (2019), reproduced in the author's manuscript; reproduction rights to be confirmed.

The initial institutional diagram emphasises national, state and district roles. The original field interpretation is that village, ward and block arrangements were comparatively weakly resourced and depended heavily on higher administrative decisions. This claim should be investigated by examining local plans, dedicated personnel, training budgets, risk maps and actual expenditures, rather than inferred solely from the absence of a box on an organisational chart. India's later creation and expansion of community-volunteer and public-alert initiatives shows that local engagement is part of national policy; their operational reach remains an area for district-specific assessment (National Disaster Management Authority, n.d.-a; National Disaster Management Authority, n.d.-b) [32, 33].

A meaningful assessment of the state tier should consider how risk information is produced and shared, which departments are responsible for drainage and embankment inspections, and how the system finances prevention before the monsoon. The question is not whether upper-tier agencies are necessary—they clearly are—but whether their functions are linked to Gram Panchayat Development Plans, annual maintenance, schools and public-health services. The 2019 national plan provides a basis for evaluating these linkages (Government of India, 2019) [18].

6.3 District Authorities, Blocks and Panchayats

The District Disaster Management Authority (DDMA) coordinates district-level planning and disaster-management responsibilities under the statutory framework. District administration is essential for integrating forecasts, evacuation assets, departments and emergency response. However, the district is not

the only legitimate site of risk governance: village councils, community organisations and households all make decisions that affect exposure and preparedness (Government of India, 2005; UNDRR, 2017) [29, 17]. Effective local governance requires clear delegation and regular interaction between these actors.
The author reports a recurring pattern in which flood-exposed households sought support from distant administrative offices for compensation, shelters, land loss or other needs. This is plausible in a complex response system but is not a measured finding for all districts. A more specific evaluation would trace the path of a warning or assistance request from a hamlet through the panchayat, block and DDMA, recording response time, eligibility rules, resources and the final outcome. Such a service-delivery audit would help distinguish policy-design gaps from implementation and coordination failures.

7. Findings: Institutional Capacity and Social Vulnerability

Three institutional layers emerged as useful analytical categories in the author's field interpretation: frontline actors closest to households (panchayats, community groups, local civil-society organisations and volunteers); district and intermediate administrations responsible for coordination and line-department services; and state or national authorities that establish policy, support finance and provide technical capacities. These are not watertight categories. Local capability depends on the relationships between them, including the availability of data, clear tasks, trusted communication channels and budgets. Table 2 summarises the author's original qualitative assessment; the categories are perceptions, not independently scored institutional performance indicators.

Table 2. Indicative Institutional-Capacity Assessment Reported In The Original Field Study

Sl. No	Institutions	Funding	Resources	Decision Making	Policy Implementation
India					
	Frontline				
1	Panchayat	Weak	Weak	Weak	Weak
2	Block	Moderate	Moderate	Moderate	Moderate
3	District	Moderate	Moderate	Strong	Strong
	State level				
4	BSDMA	Strong	Moderate	Strong	Strong
	Line ministries	Strong	Strong	Strong	Strong
	Central level				
5	Central DM Institutions (Army/ NDRF)	Strong	Strong	Strong	Strong
7	Central INGOs	Strong	Moderate	Strong	Moderate

Source: Authors' qualitative interpretation; not a statistically validated rating.

The field narrative identifies five recurrent concerns. First, locally based actors were perceived to lack dependable operating funds, equipment or staff. Second, planning responsibilities were not always matched by clear operational arrangements at the block, ward and village levels. Third, respondents described uneven training and awareness activities. Fourth, investments were perceived to favour visible engineered works and emergency relief over continuing measures that reduce livelihood insecurity. Fifth,

communication across institutions was described as episodic rather than routine. Each concern requires validation through budgets, staffing records, training registers, warning logs and observation of representative panchayat meetings.

The financing issue merits particular attention. A community may have a disaster-management committee on paper but still lack petty cash, transport, accessible shelters or maintenance resources. Conversely, a larger engineering budget does not necessarily imply that risk reduction has been neglected: embankment maintenance may be essential where people already depend on those structures. The relevant test is whether the whole portfolio addresses residual risk and is disclosed in a way local residents can scrutinise. UNDRR's global assessment highlights the importance of investment choices and the institutions through which systemic risk is governed (UNDRR, 2022) [3].

Capacity-building should be both technical and social. Elected representatives need training in risk-informed planning, local procurement and accessible information; community groups need support in household preparedness, safe evacuation, first aid and safeguarding. Programme design should consider caste, age, disability, income and gender inequalities. The Sendai Gender Action Plan provides a policy basis for involving women and women's organisations as decision-makers, not merely as relief recipients (UNDRR, 2024) [19]. Existing national volunteer programmes, including Aapda Mitra, can complement—but should not replace—ongoing institutional capability at the panchayat and block levels (National Disaster Management Authority, n.d.-b) [33].

Coordination failures can occur even where individual agencies are well resourced. An actionable arrangement would define which department issues a forecast, who translates it into local consequences, who authorises evacuation, which panchayat officials mobilise vulnerable residents and how failures are reported and reviewed. Where the Kosi crosses political boundaries, these arrangements also depend on timely data exchange and mutual trust between institutions in India and Nepal (Shrestha et al., 2024) [24].

Gandhian thought contributes an evaluative standard to this institutional analysis: public administration should be judged by its service to the least protected, rather than only by formal compliance or the volume of works completed. Swaraj implies that communities must understand and influence the decisions affecting them, while trusteeship makes transparent spending and stewardship central obligations. These values do not remove the need for competent forecasting, audited procurement, professional engineering or statutory oversight; they clarify the human purposes these systems should serve (Nachane, 2007; UNDRR, 2015) [9, 1].

7.1 Local Preparedness and Last-Mile Early Warning

The field accounts described a preparedness system that households associated more strongly with emergency relief than with continuous risk reduction. Respondents perceived a shortage of routine preparedness meetings, preventive investment and communication with residents before the monsoon. These observations are important but must be described as perceptions from the selected communities, not as proof that no preparedness programmes existed across Bihar. National policy formally recognises prevention and preparedness, while the operational challenge is to ensure their continuity at the last mile (Government of India, 2019) [18].

A recurrent theme in household narratives was that families had to protect themselves during the first days of a flood before formal assistance became accessible. Several respondents described moving possessions, finding higher ground or relying on neighbours, while shelter on embankments could create serious deficits in privacy, sanitation and safety. These reports align with earlier qualitative research documenting indigenous warning practices, difficult mobility choices and unequal coping capacity in Kosi villages

(Singh et al., 2009) [2]. The present study does not establish the frequency of these experiences across the wider basin.

Some interviewed households reported setting aside approximately INR 4,000–8,000 for seasonal food, medicine and basic preparedness, and described debt when flooding continued for longer than anticipated. This range is retained as a reported observation from the original manuscript, not a population estimate: the reporting period, price year, number of respondents and household composition were not recorded in the supplied text. These figures should be independently checked against the field notes before quantitative use.

The principal issue is not a complete absence of early-warning technology. An ICIMOD account documented how a community-based system in the transboundary Ratu watershed helped residents in a Bihar border village evacuate before a 2017 flood; a subsequent evaluation found improved upstream–downstream communication and preparedness among participating communities (Sherchan, 2017; Bajracharya et al., 2021) [34, 28]. India's SACHET platform also provides a formal mechanism for delivering disaster alerts (National Disaster Management Authority, n.d.-a) [32]. These developments demonstrate possibilities, but they do not establish reliable warning coverage for every Kosi settlement. The critical questions are geographical reach, forecast lead time, local language, trust, accessibility and the capacity to take early action (IFRC, 2012; WMO, 2023) [21, 22].

A Gandhian preparedness model would combine community ownership and indigenous knowledge with reliable science, public finance and external support. Gram panchayats could prepare annually updated risk registers naming high-exposure hamlets, safe routes, locations for livestock, households needing assistance and the facilities most likely to fail. Communities could nominate trained warning focal points, including women and marginalised residents, and review local thresholds jointly with district hydrological agencies. Local river observations should supplement—not replace—instrument readings and professional forecasts. The ICIMOD manual provides practical design elements for community-based systems using telemetry and trained personnel (Shakya et al., 2019) [35].

At least six operational commitments follow: (1) a publicly reviewed pre-monsoon preparedness plan at each gram panchayat; (2) verified flood-level and infrastructure alerts communicated through multiple channels; (3) accessible evacuation and shelter arrangements for children, older people, persons with disabilities and livestock-owning households; (4) small, transparent funds and trained local teams for immediate protective action; (5) agreed district escalation pathways and cross-border information sharing; and (6) post-monsoon community audits of what worked, who was missed and how the plan should change. Responsibility for funding and specialist response must remain clearly allocated to appropriate public authorities (UNDRR, 2015; WMO, 2023; Government of India, 2019) [1, 22, 18].

8. Discussion: Interpreting the Findings Through Gandhian Principles

The central interpretive finding is a mismatch between the geographical scale of hazard management and the scale at which households make time-sensitive decisions. Flood forecasting, infrastructure inspection and intergovernmental coordination require technical and administrative authority; safe movement, storage, assistance to people with disabilities and monitoring of excluded hamlets require dependable local organisation. Neither scale can substitute for the other [21, 35, 24, 22].

Swaraj is therefore interpreted as meaningful voice and oversight, not as withdrawal of state responsibility. Swadeshi encourages locally maintained preparedness resources without implying that communities must finance or engineer flood protection alone. Trusteeship supplies a standard for transparent spending and

fair access to shelters and assistance. Ahimsa and Sarvodaya make exclusion, unsafe shelters and preventable harm substantive governance concerns rather than peripheral welfare questions [11, 10, 9, 1, 19].

The interpretation also requires caution. The ten-village account cannot establish that panchayats throughout Bihar are uniformly weak or that flood impacts have consistently risen over time. Evidence of functioning community warning initiatives elsewhere in the transboundary region cautions against describing early warning as wholly absent. The defensible claim is that access, trust, maintenance and last-mile action vary by location, requiring locally verified diagnosis rather than generalisation [28, 35, 34].

9. Proposed Gandhian Disaster Governance Framework

The preceding analysis does not suggest that Gandhi provided a technical blueprint for managing the Kosi River. Its contribution is normative and organisational: to place human security, fairness, participation and stewardship at the centre of how technical and administrative decisions are evaluated. For the Kosi Basin, the proposed model has four mutually dependent pillars.

The first pillar is empowered local deliberation. Annual gram sabha sessions should identify risk hotspots and review the accessibility of shelters, compensation arrangements and warning systems, with meeting results publicly recorded. The second is equitable access to services: risk maps and preparedness plans must identify people for whom warnings alone are insufficient, including landless households, children, women facing mobility constraints and people requiring assisted evacuation. The third is institutional and financial reliability: panchayats must know what they can decide, which services the block and DDMA provide, and where emergency resources are available. The fourth is basin-wide evidence and cooperation: the Kosi's sediment, flood and avulsion risks demand continuing scientific assessment and coordination across the India–Nepal border (Dixit, 2009; Shrestha et al., 2024; Government of India and Government of Nepal, 1966) [6, 24, 8].

These pillars can be translated into an accountability cycle. Before the monsoon, district technical teams and panchayats jointly revise exposure maps and conduct inclusive drills. During a warning, the relevant agencies transmit risk-specific information, local teams confirm receipt and assistance is activated according to need. After the event, public records show the time and coverage of alerts, evacuation support, protective spending, relief access and unresolved grievances. The next plan incorporates what was learned.

The model can be monitored through indicators such as: proportion of high-risk hamlets with tested warning channels; percentage of identified assistance-dependent residents covered by evacuation plans; number of pre-monsoon gram sabha reviews; median warning-to-action time; availability of safe water and sanitation in shelters; and the share of mitigation expenditure disclosed locally. These are proposed measures, not results obtained in the present study.

Implementation should be phased. A district-level pilot could compare a small set of flood-prone panchayats, document local institutional resources, establish pre-intervention benchmarks and use independent community feedback after at least one monsoon cycle. Such an evaluation would clarify which components improve preparedness, which fail to reach marginalised groups and what resources are necessary to sustain the programme. Existing evidence of community-based flood warnings in the Ratu watershed provides a practical point of departure (Bajracharya et al., 2021; IFRC, 2012) [28, 21].

10. Policy Implications and Implementation Priorities

A practical first phase would select flood-exposed gram panchayats in consultation with the district

administration, document existing resources and publish village-level exposure and evacuation maps. Before each monsoon, panchayat and district officials should agree on alert thresholds, message channels, transport support and shelter responsibilities. Public meetings should record which hamlets and vulnerable groups have been consulted and which corrective actions remain unfunded [18, 21, 32, 35, 19].

A second phase should establish small, auditable preparedness allocations and joint technical reviews of drainage, embankment condition and access routes. Monitoring indicators could include warning receipt and comprehension, time from alert to action, proportion of priority households with safe evacuation arrangements, functionality of shelters, frequency of public expenditure disclosure and closure of grievances. These are proposed indicators, not outcomes measured by this study [33, 1, 3, 22].

At the transboundary scale, the policy priority is dependable and timely communication of river conditions and forecast uncertainty between relevant authorities in Nepal and India, coupled with local translation into specific protective action. This complements rather than replaces hydraulic engineering, river monitoring and national disaster-management institutions [23, 8, 24, 25].

11. Research Limitations and Future Research

The original account describes visits to ten villages, ten household surveys and ten focus-group discussions, but supporting interview transcripts, sampling frame, dates, consent records and coding materials were not available for independent reanalysis. The findings must therefore be treated as qualitative interpretations rather than verified prevalence estimates. The institutional-capacity table is an indicative author assessment, not a validated index. The household preparedness cost range is a reported recollection and should not be interpreted as a population statistic.

Future research should document sampling and ethics procedures, triangulate household accounts with administrative budgets and warning logs, and compare panchayats with different levels of exposure and institutional support. A prospective pilot of the proposed framework could assess whether more inclusive warning, transparent local finance and routine community deliberation improve preparedness and reduce avoidable losses. Any evaluation should also account for differences in river conditions and infrastructure risk [20, 24, 7, 3].

12. Conclusion

The Kosi Basin illustrates a central dilemma of disaster governance: major hydraulic infrastructure and formal institutions can coexist with persistent local vulnerability. The river's sediment dynamics, avulsions and transboundary setting make technical competence indispensable, while household accounts emphasise the everyday burdens of insecure livelihoods, uncertain assistance and unequal access to actionable information. A balanced assessment does not reject engineering or portray government intervention as uniformly ineffective. It asks whether engineering, ecological management, social protection and local decision-making function together to reduce risk for people who face the greatest losses.

Gandhian principles offer a coherent ethical lens for this question. Swaraj prioritises meaningful community voice; Swadeshi calls attention to locally sustained capacities; trusteeship demands accountable use of resources; and non-violence and service insist on dignity and non-discrimination. Their practical value will depend on whether they are converted into funded responsibilities, measurable preparedness actions and fair institutional procedures. Evidence from community-based warning systems confirms that grassroots participation can strengthen preparedness when supported by credible data, trained personnel and organised communication (Sherchan, 2017; Bajracharya et al., 2021) [34, 28].

The paper recommends routine gram sabha risk reviews; clearly funded local preparedness responsibilities; inclusive multi-channel early warning; joint monitoring of embankments, drainage and safe evacuation routes; public reporting of expenditures and unmet needs; and regular India–Nepal exchange of usable risk information. A further research priority is to test this model through documented, ethically conducted comparative fieldwork. The study's current interview details and figure provenance require author verification. The defensible conclusion is therefore a governance proposition, not an experimentally established causal effect: a Gandhian, people-centred approach can guide more accountable and equitable Kosi flood-risk management when embedded in capable, evidence-based and properly resourced institutions.

References

1. United Nations Office for Disaster Risk Reduction, “Sendai Framework for Disaster Risk Reduction 2015–2030”, United Nations, 2015. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030
2. Praveen Singh, Nilanjan Ghose, Nitin Chaudhary, Regina Hansda, “Life in the Shadow of Embankments: Turning Lost Lands into Assets in the Koshi Basin of Bihar, India”, International Centre for Integrated Mountain Development, 2009. https://lib.icimod.org/records/d3kxa-k8396
3. United Nations Office for Disaster Risk Reduction, “Global Assessment Report on Disaster Risk Reduction 2022: Our World at Risk”, United Nations, 2022. https://www.undrr.org/gar/gar2022-our-world-risk-gar
4. Intergovernmental Panel on Climate Change, “Climate Change 2022: Impacts, Adaptation and Vulnerability, Chapter 10: Asia”, Working Group II Contribution to the Sixth Assessment Report, 2022. https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-10/
5. International Centre for Integrated Mountain Development, “Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya: An Outlook”, International Centre for Integrated Mountain Development, 2023. https://lib.icimod.org/records/wzyaa-09x64
6. Ajaya Dixit, “Kosi Embankment Breach in Nepal: Need for a Paradigm Shift in Responding to Floods”, Economic and Political Weekly, 2009, 44 (6), 70–78. https://www.jstor.org/stable/40278487
7. Rajiv Sinha, “The Great Avulsion of Kosi on 18 August 2008”, Current Science, 2009, 97 (3), 429–433. https://www.jstor.org/stable/24112012
8. Government of India, Government of Nepal, “Revised Agreement Concerning the Kosi Project”, Kathmandu, 19 December 1966, Ministry of External Affairs treaty record. https://www.mea.gov.in/Portal/LegalTreatiesDoc/NP66B1487.pdf
9. Dilip M. Nachane, “Gandhian Economic Thought and Its Influence on Economic Policymaking in India”, The Legacy of Gandhi: A 21st Century Perspective, Institute of South Asian Studies, 2007. https://www.files.ethz.ch/isn/46799/26.pdf
10. John S. Moolakkattu, “Mahatma Gandhi and the Environment”, The Energy and Resources Institute, 1 October 2019. https://www.teriin.org/article/mahatma-gandhi-and-environment
11. Amandeep Kaur, Bhupinder Singh, “Relevance of Gandhian Economic Thought: An Appraisal”, International Journal of Advanced Research in Management and Social Sciences, January 2015, 4 (1), 115–123. https://indianjournals.com/article/ijarmss-4-1-012

12. World Bank, "South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards", World Bank, 28 June 2018. https://www.worldbank.org/en/region/sar/publication/south-asias-hotspots
13. Michael Nagler, "From Principles to Practice: Gandhian Economics", Metta Center for Nonviolence, recorded talk, 23 February 2013. https://www.youtube.com/watch?v=KbyuHXZhBlY
14. Kaushik Das Gupta, "Relevance of Gandhian Environmentalism", Down To Earth, 30 January 2017. https://www.downtoearth.org.in/amp/story/environment/relevance-of-gandhian-environmentalism-56906
15. Jianqiang Zhang, Cees J. van Westen, Hakan Tanyas, Olga Mavrouli, Yonggang Ge, Samjwal Bajracharya, Deo R. Gurung, Megh R. Dhital, Narendra R. Khanal, "How Size and Trigger Matter: Analyzing Rainfall- and Earthquake-triggered Landslide Inventories and Their Causal Relation in the Koshi River Basin, Central Himalaya", Natural Hazards and Earth System Sciences, 2019, 19, 1789–1805. https://doi.org/10.5194/nhess-19-1789-2019
16. Government of India, "The Constitution of India, Article 243G and the Eleventh Schedule", Ministry of Law and Justice, as amended. https://upload.indiacode.nic.in/showfile?actid=AC_DH_62_1008_00005_00005_1561028196113&filename=the_constitution_of_india.pdf&type=actfile
17. United Nations Office for Disaster Risk Reduction, "Terminology: Disaster Risk Governance", United Nations, terminology record, 2017. https://www.undrr.org/terminology/disaster-risk-governance
18. National Disaster Management Authority, "National Disaster Management Plan, Revised Edition", Government of India, November 2019. https://nyks.nic.in/NewInitiatives/NDRF/Letters/NationalDisasterManagementPlan2019.pdf
19. United Nations Office for Disaster Risk Reduction, "Gender Action Plan to Support Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030", United Nations, 2024. https://www.undrr.org/news/what-sendai-gender-action-plan
20. T. Chakraborty, R. Kar, P. Ghosh, S. Basu, "Kosi Megafan: Historical Records, Geomorphology and the Recent Avulsion of the Kosi River", Quaternary International, 2010, 227 (2). https://doi.org/10.1016/j.quaint.2009.12.002
21. International Federation of Red Cross and Red Crescent Societies, "Community Early Warning Systems: Guiding Principles", International Federation of Red Cross and Red Crescent Societies, 2012. https://www.ifrc.org/document/community-early-warning-systems-guiding-principles
22. World Meteorological Organization, "Overview of the Early Warnings for All: Executive Action Plan 2023–2027", WMO Bulletin, 2023, 72 (1). https://wmo.int/resources/wmo-bulletin/wmo-bulletin-vol-72-1-2023/overview-of-early-warnings-all-executive-action-plan-2023-2027
23. N. Chen, G. Hu, W. Deng, N. R. Khanal, Y. Zhu, D. Han, "On the Water Hazards in the Trans-boundary Kosi River Basin", Natural Hazards and Earth System Sciences, 2013, 13, 795–808. https://doi.org/10.5194/nhess-13-795-2013
24. Manish Shrestha, Mandira S. Shrestha, Dilip K. Gautam, Thanapon Piman, Diganta Barman, Atul A. Pandey, Dharam R. Uprety, "Exploring Flood Modelling in the Koshi River Basin: Challenges and the Way Forward – State of Knowledge", International Centre for Integrated Mountain Development, 2024. https://doi.org/10.53055/ICIMOD.1045
25. Jianqiang Zhang, Amar D. Regmi, Rongkun Liu, Narendra R. Khanal, Luca Schenato, Deo R. Gurung, Shahriar Wahid, "Landslides Inventory and Trans-boundary Risk Management in Koshi River Basin,

Himalaya", Land Cover Change and Its Eco-environmental Responses in Nepal, Springer Geography, 2017, 409–426. https://doi.org/10.1007/978-981-10-2890-8_18
26. Dilip Kumar, "Flood and Sediment Management in Kosi River", World Water Congress, International Water Resources Association, 2015. https://iwra.org/proceedings/index.php?abstract_id=2176&eventid=5&page=286
27. Chintaman V. Gole, Shrikrishna V. Chitale, "Inland Delta Building Activity of Kosi River", Journal of the Hydraulics Division, 1966, 92 (2), 111–126. https://doi.org/10.1061/JYCEAJ.0001406
28. Sagar R. Bajracharya, Narendra R. Khanal, Pashupati Nepal, Sundar K. Rai, Pawan K. Ghimire, Neera S. Pradhan, "Community Assessment of Flood Risks and Early Warning System in Ratu Watershed, Koshi Basin, Nepal", Sustainability, 2021, 13 (6), 3577. https://doi.org/10.3390/su13063577
29. Government of India, "The Disaster Management Act, 2005", Act No. 53 of 2005, as amended. https://www.indiacode.nic.in/indiacode/handle/123456789/18558?view_type=browse
30. National Disaster Management Authority, "National Policy on Disaster Management, 2009", Government of India, 2009. https://ndmindia.mha.gov.in/ndmi/images/national-dm-policy2009.pdf
31. Government of India, "The Disaster Management (Amendment) Act, 2025", Act No. 10 of 2025, 29 March 2025. https://prsindia.org/files/bills_acts/acts_parliament/2025/The_Disaster_Management_Act%2C_2025.pdf
32. National Disaster Management Authority, "SACHET: National Disaster Alert Portal, About the System", Government of India, online portal, accessed 13 November 2026. https://sachet.ndma.gov.in/About
33. National Disaster Management Authority, "Aapda Mitra: Community Volunteer Training Programme", Government of India, online programme, accessed 13 November 2026. https://aapdamitra.ndma.gov.in/training-updates
34. Ujol Sherchan, "Making Flood Information Travel Faster Than Flood Waters", International Centre for Integrated Mountain Development, 2017. https://www.icimod.org/article/making-flood-information-travel-faster-than-flood-waters-timely-early-warnings-give-flood-vulnerable-communities-in-the-ratu-river-koshi-basin-adequate-time-for-flood-preparedness-and-response/
35. D. Shakya, V. R. Khadgi, N. Bajracharya, S. R. Bajracharya, S. K. Rai, N. S. Pradhan, "Community Based Flood Early Warning System Resource Manual: Revised Edition for Telemetry Based Instrumentation", International Centre for Integrated Mountain Development, 2019. https://lib.icimod.org/records/vbt9h-mwr50